The Influence of Video Game Music on Verbal Reasoning Task Performance

Research Thesis

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by

Kayla Toon

The Ohio State University

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Project Advisor: Professor James Alex Bonus, Department of Communication

Echoing media coverage of the “Mozart effect” in the mid-1990s, recent popular press reports have propagated the idea that listening to video game music can enhance worker productivity and improve task performance. The current experiment empirically tested this possibility. Undergraduates (N = 513) completed two verbal reasoning tasks, one while in silence and one while listening to music from either (1) classical composers or (2) popular video game franchises (i.e., *The Sims* or *Super Mario*). Results indicated that participants’ self-reported mood, arousal, and attention did not differ across conditions. Although listening to music from *Super Mario* caused participants to perform worse on the verbal reasoning task, this detrimental effect did not occur among participants who had prior experience playing *Super Mario* video games. These results provide minimal support for the idea that video game music influences task performance in ways that are unique from other types of music.

Pursuit of empirical evidence supporting the Mozart effect has largely halted in recent years. Indeed, the rather dubious notion that listening to Mozart music can enhance intelligence (Rauscher, Shaw, & Ky, 1993) has been contradicted by manifold failed attempts to replicate the effect (Pietschnig, Voracek, & Formann, 2010). Although endorsement of this neuromyth among the general public persisted long after it was abandoned by academic researchers (Beauvais, 2015), recent evidence suggests that this support might also be starting to wane relative to other popular neuromyths (Im, Cho, Dubinsky, & Varma, 2018; Macdonald, Germine, Anderson, Christodoulou, &McGrath, 2017).

Despite this progress, new iterations of the Mozart effect periodically emerge in the public consciousness. For example, a wildly lucrative series of infant-directed videos (i.e., *Baby Einstein*) featuring music by classical composers was successfully marketed to parents in the early 2000s as supportive of early language development, even though empirical research later cast doubt on these educational benefits (DeLoache et al., 2010; Ferguson & Donnellan, 2013). More recently, online blogs and popular news media have started to popularize what might best be described as a "*Mario* effect": the idea that listening to video game music while working can enhance focus, boost productivity, and improve task performance (e.g., Chodosh, 2018; Ferro, 2018). Although this notion is intuitively appealing and is grounded in reasonable empirical insights, there are some reasons to believe that video game music might actually be more detrimental (or, at least, no more influential) than other types of music for task performance.

The current experiment examined the *Mario* effect. Specifically, two separate (and arguably conflicting) theoretical accounts were used to derive hypotheses about the possible impact of video game music on task performance: (1) the mood-arousal hypothesis and (2) the seductive detail effect. Because scholars have suggested that the effects of listening to music on task performance might vary by one’s familiarity with specific musical stimuli (Thompson, Schellenberg, & Letnic, 2011), prior experience playing video games was examined as a possible moderator of these effects. These results provide insights about the unique characteristics of video game music, while also highlighting the importance of empirically testing popular lay beliefs that are purportedly rooted in scientific evidence.

Theoretical Perspectives on Music and Task Performance

Initial examination of the Mozart effect was relegated to the study of one specific sonata (i.e., KV 448) and one specific task (i.e., assessments of spatial intelligence). Consequently, efforts to replicate the effect using other stimuli and tasks provided inconsistent results. Indeed, improvements in task performance were primarily documented when participants who listened to the sonata were compared to participants who sat in silence (Chabris, 1999; Hetland, 2000). Other studies featuring control groups where participants listened to equally interesting audio stimuli (e.g., other songs or popular audio books) revealed that similar improvements emerged regardless of the audio stimuli chosen, and that these benefits were largely a function of participants’ preference for the focal stimulus (Nantais & Schellenberg, 1999). Relatedly, studies using different types of tasks (e.g., spatial tasks vs. memory recall vs. reading comprehension) have found that music sometimes degrades (rather than improves) performance (e.g., Lehman & Suefert, 2017). Collectively, this research has led scholars to acknowledge that the effects of music listening are far from monolithic, and instead depend on the specific types of emotional/physiological responses (i.e., *the mood-arousal hypothesis*) and cognitive responses (i.e., *the seductive detail effect*) elicited by the listening experience.

The mood-arousal hypothesis. Under the mood-arousal hypothesis, *mood* refers to lasting emotions and *arousal* refers to the degree or intensity of a physiological or emotional response (Husain, Thompson, & Schellenberg, 2002). The hypothesis suggests that task performance improves in response to optimal levels of mood and arousal, whereas it degrades in response to less-than-optimal levels (Thompson, Schellenberg, & Husain, 2001). For example, research has demonstrated that positive mood (e.g., positive affect, happiness, enjoyment) is more conducive to task performance than negative mood (e.g., negative affect, dislike, anger). Importantly, these emotional responses typically vary as a function of participants' preferences for particular music selections (i.e., beloved music results in more positive mood; Cassidy & Macdonald, 2010; Nantais & Schellenberg, 1999) and with regard to certain features of the music (e.g., songs performed in the major key result in more positive mood, whereas songs performed in a minor result in more negative mood; Husain et al. 2002).

Research on arousal has generally supported the Yerkes-Dodson Law (Yerkes & Dodson, 1908), such that moderate levels of arousal (e.g., feeling lively and focused) benefit task performance, whereas both low levels of arousal (e.g., feeling bored and tired) and high levels of arousal (e.g., feeling jittery and stressed) degrade performance (Lim & Park, 2018; Nguyen & Grahn, 2017). Of course, these effects are somewhat contingent upon the demands inherent to a particular task. For example, high arousal seems particularly detrimental for tasks that require deep mental focus (e.g., reading comprehension; Thompson et al., 2011), whereas it is beneficial for tasks that involve bodily movement (e.g., running and lifting weights; Kampfe, Sedlmeier, & Renkewitz, 2010). The tempo (i.e., speed) and intensity (i.e., volume) of music seem to have the most potent impact on arousal, such that loud/fast songs tend to enhance arousal, whereas quiet/slow songs tend to reduce arousal (e.g., Dillman Carpentier & Potter, 2007).

The seductive detail effect. People are limited in the amount of working memory they have available at any one moment to commit to processing a particular task. Consequently, listening to music while simultaneously completing another task places a burden on working memory by requiring people to split their attention between the task at hand and an unrelated audio stimulus. Lehman and Seufert (2017) refer to such audio distractions as *seductive details*. Generally, researchers view seductive details as detrimental for task performance because they hinder one's ability to focus solely on a primary task (Rey, 2012). Indeed, meta-analyses have found that listening to music (relative to silence) has an overall negative impact on tasks that otherwise require deep mental focus (e.g., reading comprehension; Kampfe et al., 2010). These effects are particularly burdensome when the focal task and concurrent audio stimulus require individuals to simultaneously process similar types of information. For example, one experiment found that office workers exhibited worse performance on a proofreading task while listening to recordings of human speech compared to when they listened to recordings of other sounds (e.g., white noise; Venetjoki, Kaarala-Tuomaala, Keskinen, & Hongisto, 2006).

Of course, the extent to which music functions as a seductive detail predictably varies across individuals. For example, research has shown that individuals with higher working memory are less affected by the presence of seductive details compared to individuals with lower working memory, who tend to find those details more distracting (Lehman & Suefert, 2017; Sanchez & Wiley, 2006). Similarly, familiar pieces of music tend to be less distracting than unfamiliar pieces of music because fewer cognitive resources are needed to process familiar audio. For example, Cassidy and Macdonald (2010) found that participants' performance in a racing video game (i.e., overall speed and completion time) was better when they were able to select their own music to listen to while playing, whereas performance worsened when the researcher selected the music.

The Puzzle of Video Game Music

Video game music remains understudied by music psychologists, and available studies that reference it largely do so anecdotally. For example, Treger (2018) describe the pop-culture phenomenon *Guitar Hero* as a possible catalyst for children's love of music, whereas Marvin, VanderStel, and Siu (2019) offer the compelling story of a musician who began developing his gift of absolute pitch while playing *Banjo Tooie*. The few studies that have treated video game music with serious scholarly interest have largely focused on the ways in which this music generates immersion, engagement, and enjoyment during gameplay (Klimmt, Possler, May, Auge, Wanjek, & Wolf, 2018; Zhang & Fu, 2015). Of course, it is this latter domain of research that has reinvigorated public interest in the Mozart effect and propagated the idea that people should listen to video game music while working in order to boost their productivity. For example, Chodosh (2018) writes: "It's a whole genre designed to simultaneously stimulate your senses […] It has to engage you, the player, in a task without distracting from it." Ferro (2018) concurs: "Game music often has a lot of repetition, along with variation on musical themes, to keep the player engaged but still focused on what they're playing."

While these arguments provide an accurate summary of the existing research on video game music, it isn't evident that these qualities translate to improved task performance. For example, Klimmt et al. (2018) randomly assigned undergraduates to play a video game with or without its associated soundtrack and found that participants who played the game with music reported more positive emotions (e.g., inspired, proud, enthusiastic), feelings of arousal (e.g., active, alert, attentive), and overall enjoyment than participants who played without music. Using a similar manipulation, Zhang and Fu (2015) found that immersion was higher among undergraduates when gameplay was paired with (vs. without) music, though this effect only occurred among participants with less gaming experience (experienced gamers reported high levels of immersion across both conditions). Contextualizing these results within the available literature, Klimmt et al. (2018) argue that video game music—like film music—elicits emotional responses that intensify audiences' experiences of narrative content because the music is purposefully orchestrated to fluctuate with the progression of the story (Cohen 2001).

But what happens when this music is dissociated from its source material and applied to an unrelated task? Although the immersive qualities of this music should continue to amplify mood and arousal, it might simultaneously serve as a seductive detail that draws attention away from the task at hand. Consequently, it is unclear whether this content should help task performance (via positive mood and optimal arousal) or hurt task performance (via distraction). It is also possible that these effects might vary as a function of one's prior experience playing video games. On the one hand, individuals who often play video games might find this music more enjoyable and arousing than individuals who rarely or never play video games. By the same token, it is also possible that these prior experiences would also make this content more distracting. Indeed, research shows that exposure to video clips of beloved video games from one's childhood (e.g., *Super Mario Kart*) triggers memories associated with playing that content in the past (Natterer, 2014), and similar results have been identified when people encounter popular music from their adolescence (Bonus, 2018). Consequently, the act of encountering familiar video game music when completing a separate task might trigger memories associated with playing that game and thus generate even higher levels of distraction for serious gamers.

The Current Study

The current study examined if video game music influences task performance in ways that are unique from other types of orchestral music. Task performance was operationalized as a verbal reasoning test. This particular task was selected for two reasons. First, previous research has found that music sometimes enhances (Kallinen, 2002), degrades (Furnham & Bradley, 1997), or has no impact on reading comprehension (Furnham & Allass, 1999) depending on qualities of both the music and the listener. Consequently, verbal reasoning tasks seemed capable of capturing wide variability in participants' (possibly divergent) responses to music. Second, college students report listening to music while studying more than they report engaging in any other unrelated activities (e.g., surfing the web, texting, snacking; Calderwood, Ackerman, & Conklin, 2014), and these study sessions often feature reading comprehension tasks (Fox, Rosen, & Crawford, 2009). Thus the use of a verbal reasoning task also seemed to be an ecologically-valid context in which to investigate the effects of music on task performance.

In the current study, undergraduate students were assigned to complete two separate verbal reasoning tests: one test was completed in silence, whereas the other test was completed while listening to a musical excerpt. For the test paired with music, participants were randomly assigned to listen to audio excerpts from a well-known video game franchise or from a collection of songs composed by classical musicians. As previously noted, video game music has been shown to generate high levels of positive affect and optimal arousal (Klimmt et al., 2018). However, extracting this music from the context in which it was designed to be enjoyed and applying it in a novel situation might cause it to draw attention away from the task at hand. As a result, it was unclear whether the potentially contradictory effects of video game music would serve to improve or degrade performance on a verbal reasoning task. The following hypothesis and research question were posed:

H1: Video game music will improve mood **(a)**, enhance arousal **(b)**, and increase distraction **(c)** relative to silence.

RQ1: Will video game music influence verbal reasoning task performance?

Two recent criticisms of research in media psychology also shaped the direction of this project. First, Reeves, Yeykelis, and Cummings (2015) noted that media psychologists often fail to include multiple exemplars of media stimuli in their studies and thus make unwarranted generalizations based on unrepresentative samples of content. Second, Valkenburg and Peter (2013) noted that media psychologists often fail to test key moderators in their analyses. Accordingly, the current study also examined whether the proposed effects of video game music generalize beyond one exemplar of video game music, as well as whether these effects were influenced by relevant individual difference variables.

Specifically, participants in the video game condition were further randomized to hear music from one of two popular video games (i.e., *The Sims* vs. *Super Mario*) at one of two different speeds (slow vs. fast tempo). Songs from these specific franchises were chosen because they have been explicitly identified in the popular press as potentially beneficial for task performance (Ferro, 2018), whereas tempo was manipulated because prior research has indicated that it can influence both arousal and task performance independently of other features of the music (Dillman Carpentier & Potter, 2007; Husain et al., 2002; Thompson et al., 2001). Moreover, the extent to which participants had previously played each of these two focal video games was assessed. This variable was included because previous research suggests that it might influence the extent to which participants enjoy that music (Cassidy & Macdonald, 2010) and the number of available memories they might recall by listening to it (Natterer, 2014). Three additional research questions were posed:

RQ2: Will the effects of video game music on mood, arousal, distraction and task performance be moderated by video game franchise (*The Sims* vs. *Super Mario*)?

RQ3: Will the effects of video game music on mood, arousal, distraction, and task performance be moderated by tempo (slow vs. fast)?

RQ4: Will the effects of video game music on mood, arousal, distraction, and task performance be moderated by prior gameplay experience?

Method

Participants

Power analyses (using G*Power) indicated that a sample size of 390 was required to detect interactions in a repeated-measures ANOVA with a small effect size (specified with three experimental conditions, $\alpha = .05$, power = .95). Consequently, participants were 513 undergraduates at a large Midwestern university (age $M = 20.35$, $SD = 2.78$, range: 18-44; 71.20% female with one participant identifying as non-binary). The majority of respondents were Caucasian (67.10%), while the remainder of the sample was composed of participants who were Asian (22.60%), African American (9.40%), Hispanic/Latino (3.5%), Native American (0.6%) or other (2.5%). Participants could select more than one category.

Design and Materials

This was a 3 (music type: classical vs. *The Sims* vs. *Super Mario*) x 2 (tempo: slow vs. fast) x 2 (testing context: in silence vs. with music) mixed design. Music type and music tempo were both between-subjects factors, whereas testing context was a within-subjects factor.

Verbal reasoning task performance was assessed using practice versions of the Graduate Record Examinations (GRE) test (Fox et al., 2009; Thompson et al., 2011). Two separate verbal reasoning tests of equivalent difficulty were drawn from-a GRE test prep booklet (Peterson, 2018). Each test consisted of 20 multiple-choice questions, comprised of five text completion questions, four sentence equivalence questions, and eleven critical reading questions.

Musical excerpts were created for each condition by editing together three songs that were approximately 3.5-minutes in length. Each medley was 10 minutes total, and there were six total medleys (i.e., one for each of the three music conditions at two different tempos). All songs were drawn from music available on YouTube. Songs from *The Sims* and *Super Mario* were drawn from popular games from each franchise, and classical songs were drawn from a variety of classical composers (e.g., Franz Schubert, Franz Joseph Haydn). Consistent with prior research (e.g., Husain et al., 2002; Thompson et al., 2011), songs in the slow tempo condition ranged from 60 bpm and 96 bmp, whereas songs in the fast tempo condition ranged from 120 bpm to 152 bpm (see Table 1).

Procedure

Participants were invited to participate in an online experiment about the effects of listening to music while studying in exchange for extra credit in their communication classes. Alternative assignments were available as a way to obtain extra credit for students who did not wish to participate. After giving informed consent, participants were instructed to ensure that they were in a quiet space with no distractions. After proceeding with the study, they were told that they would take two verbal reasoning tests, one without music and one with music. For each test, they were told to complete as many questions as accurately as possible in 10 minutes. They were also told that they were free to consult any other resources (e.g., books, websites) to help them answer accurately. The study automatically proceeded after 10 minutes had elapsed. The presentation order of the two verbal reasoning tests was counterbalanced across participants, and the order in which they took these tests (i.e., with or without music) was also counterbalanced across participants. After each test, participants answered questions about their mood, arousal, and distraction. After completing both tests, participants answered questions about their demographics and their prior experience playing video games.

Measures

Mood. After each test, participants indicated their mood using four semantic differential items (i.e., unhappy-happy, annoyed-pleased, unsatisfied-satisfied, despairing-hopeful; Bradley & Yang, 1994). They responded using a 7-point scale, and their responses to all four items were averaged separately for each test (in silence $M = 3.82$, $SD = 1.17$, $\alpha = .87$, range: 1 - 7; with music $M = 3.73$, $SD = 1.27$, $\alpha = .88$, range: 1-7). Higher scores indicated more positive mood.

Arousal. After each test, participants indicated their arousal using four semantic differential items (i.e., relaxed-stimulated, calm-excited, dull-jittery, sluggish-frenzied; Bradley & Yang, 1994). They responded using a 7-point scale, and their responses to all four items were averaged separately for each test (in silence $M = 3.31$, $SD = 1.09$, $\alpha = .77$, range: 1 - 7; with music $M = 3.66$, $SD = 1.22$, $\alpha = .83$, range: 1 - 7). Higher scores indicated higher arousal.

Distraction. After each test, participants responded to three items created for the current study: "I wasn't very focused while completing the verbal reasoning test", "My mind often wandered while completing the verbal reasoning test", and "I found it hard to pay attention to the verbal reasoning test". Participants indicated their agreement with each item using a 7-point scale (1 = *strongly disagree*, 7 = *strongly agree*), and their responses to all three items were averaged separately for each test (in silence $M = 4.36$, $SD = 1.56$, $\alpha = .88$, range: 1 - 7; with music $M = 4.94$, $SD = 1.49$, $\alpha = .86$, range: 1 - 7). Higher scores indicated more distraction.

Verbal reasoning task performance. Participants' responses to each multiple-choice question were scored as correct (1 point) or incorrect (0 points). Their score for each test was calculated by summing their correct responses (in silence $M = 5.00$, $SD = 2.49$, range: 0-15; with music $M = 4.86$, $SD = 2.53$, range: 0-15). Higher scores indicated better performance.

Video game experience. Participants were provided a brief description of *The Sims* and *Super Mario* video game franchises. For each franchise, they were asked if they had ever played any video game installment in that franchise (0 = *no*, 1 = *yes*). Across all participants, 53.6% indicating playing at least one game from *The Sims* and 90.6% indicated playing at least one game from *Super Mario*. Participants who said yes also indicated how much they played four titles from each franchise using an 11-point scale (0 = *never*, 10 = *a lot*). Scores were averaged across all four titles for each game (*The Sims* $M = 1.53$, $SD = 2.33$, $\alpha = .81$, range: 0-10; *Super Mario* $M = 2.56$, $SD = 2.44$, $\alpha = .77$, range: 0-10). Higher scores indicated more experience.

Results

The dataset and syntax for all analyses is available at https://osf.io/85gby/?view_only=7d96882cc65947a0b5c1aed51e2d0c15. Analyses were conducted using SPSS v. 24. Hypotheses and research questions were assessed using repeated-measures ANOVAs. Testing context (in silence vs. with music) was a within-subjects factor, whereas music type (classical vs. *The Sims* vs. *Super Mario*) and music tempo (slow vs. fast) were between-subjects factors. Mean scores and standard errors for each outcome in every condition are reported in Table 2 (music type) and Table 3 (music tempo).

Contrary to H1, there was no interaction between music type and testing context in the analyses predicting mood, $F(2,507) = .49$, $p = .616$, arousal, $F(2,507) = 1.11$, $p = .331$, or distraction, $F(2,507) = 1.02$, $p <.001$. However, with regard to RQ1 and RQ2, there was a significant interaction between music type and testing context in the analysis predicting verbal reasoning task performance, $F(2,507) = 3.10$, $p = .046$, partial-η^2= .01. Relative to silence, verbal reasoning task performance was significantly lower in the *Super Mario* condition (p = .022, partial-η^2= .01; see Table X). However, there was no effect of either classical music (p = .235) or *The Sims* music (p = .349) on task performance.

With regard to RQ3, there were no significant three-way interactions between testing context, music type, and music tempo. However, there were significant two-way interactions between testing context and tempo in the analysis predicting mood, $F(1,507) = 5.85$, $p = .016$, partial-η^2= .01, and in the analysis predicting arousal, $F(1,507) = 29.72$, $p < .001$, partial-η^2= .06. Relative to silence, fast tempo music diminished mood (p = .006, partial-η^2= .02) and enhanced arousal (p < .001, partial-η^2= .12; see Table 3), whereas slow tempo music had no impact on mood (p = .517) or arousal (p = .611). These effects were consistent across all three music conditions (i.e., classical, *The Sims*, and *Super Mario*).

Only one significant effect emerged in the analysis predicting distraction. There was a main effect of testing context, $F(1,507) = 42.28$, $p < .001$, partial-η^2= .08, such that participants reported feeling more distracted when taking the test with music (M = 4.94, SE = .07) than they did when taking the test in silence (M = 4.36, SE = .07). These effects were consistent across all three music conditions (i.e., classical, *The Sims*, and *Super Mario*) and both tempo conditions (i.e., fast and slow).

RQ4 was addressed with a series of moderation analyses using Hayes' (2018) Process macro. In all cases, music type (classical vs. *Sims* vs. *Mario*) was the predictor and the classical music condition served as the reference group. Four separate outcome variables were assessed: mood, arousal, distraction, and task performance. For each analysis, participants' score when listening to music was entered as the outcome, whereas their score when in silence was entered as a covariate. Two separate analyses were conducted for each outcome: one with participants' prior experience playing *The Sims* as the moderator, and another with participants' prior experience playing *Super Mario* as the moderator.

Only one of these analyses provided evidence of moderation. Specifically, prior experience with *Super Mario* interacted with the *Mario* music condition ($B = .22$, $SE = .11$, $p = .035$) in the analysis predicting task performance ($R^2 = .28$, $p < .001$). Johnson-Neyman's analysis indicated that the detrimental effect of *Mario* (vs. classical) music only occurred among participants who had relatively little experience playing *Super Mario* ($B = -.98$, $SE = .33$, $p = .003$), but this effect was not significant among participants who had an average amount of experience playing *Super Mario* ($B = -.45$, $SE = .24$, $p = .059$) or a lot of experience playing *Super Mario* ($B = .09$, $SE = .37$, $p = .805$).

Discussion

Responding to recent criticisms of the narrow approach taken by many studies in media psychology (Reeves et al., 2015; Valkenburg & Peter, 2013), the current experiment provided a robust test of the "*Mario* Effect" (i.e., the lay belief that video game music can improve task performance; Chodosh, 2018; Ferro, 2018). Specifically, the current study featured a large sample size, it utilized a repeated-measures design, it was sufficiently powered to detect small effects, it tested multiple exemplars of video game music from two different media franchises, it tested songs of varying tempo within each franchise, and it examined relevant moderator variables. Collectively, there was minimal evidence that video game music had a unique influence on task performance relative to classical music. Importantly, to the extent that there was evidence of an effect, video game music actually degraded (rather than improved) task performance. However, the size of this effect was small, it occurred for only one of the media franchises examined (i.e., *Super Mario* and not *The Sims*), and it did not occur among participants with prior experience playing video games from that franchise.

In fact, the current study actually identified manifold similarities between video game music and classical music. In partial support of the mood-arousal hypothesis, fast music diminished mood and enhanced arousal, and these effects occurred regardless of the type of music that participants heard (i.e., video game vs. classical). Consistent with the seductive detail effect, participants found that taking the verbal reasoning test with music was more distracting than taking the test in silence. Again, these effects occurred regardless of the type of music that participants heard (i.e., video game vs. classical) and regardless of the tempo of those songs (i.e., fast vs. slow). These findings indicate that video game music—once dissociated from its source material—operates on mood, arousal, and cognition in largely the same ways as other forms of orchestral music, and that both video game music and classical music appear to have little influence on the specific verbal reasoning task used in the current study (i.e., a timed GRE test).

Of course, the fact should not be ignored that music from the *Super Mario* franchise slightly diminished task performance among participants who had little experience playing video games from the *Super Mario* franchise. It is unclear what characteristics of the music might have resulted in this effect. However, consistent with the general style of the *Super Mario* video game franchise, some of the music used in the *Super Mario* condition featured 8-bit sound effects (e.g., "Bob-Omb Battlefield" from *Super Mario 64*), whereas all of the music used in *The Sims* condition featured traditional orchestral instruments. It is possible that the 8-bit style of some of the *Super Mario* songs was more jarring for participants who weren't otherwise accustomed to hearing those types of sounds in music. If this were the case, then it is somewhat surprising that participants did not report feeling more distracted by this music. However, it is also possible that the self-report measure of distraction included in this study was not sensitive enough to capture nuanced shifts in participants' responses to different types of music. Future research should compare the effects of instrumental music, 8-bit music, and other types of music (e.g., songs composed using synthesizers) that are relatively unique to video game music while also incorporating measures of attention that circumvent the need for self-report, such as physiological indicators (e.g., heart rate deceleration) or eye-tracking.

This deleterious effect of music from *Super Mario* should also not be misconstrued as a rebuke of video game music more generally. Indeed, the participants in this study who would presumably be most likely to listen to this music (i.e., those who had the most experience with the *Super Mario* franchise) did not exhibit any reduction in task performance when listening to this music. Consequently, these findings lend support for the notion that the impact of music on task performance is often a function of one's familiarity with (and enjoyment of) particular musical selections rather than a response to specific qualities of the music itself (Cassidy & Macdonald, 2010; Nantais & Schellenberg, 1999; Thompson et al., 2011). Moreover, recent research has shown that playing certain types of video games can enhance cognitive functioning (Green & Seitz, 2015), including the ability to multi-task (Strobach, Frensch, & Schubert, 2012). The fact that music from *Super Mario* did not diminish the verbal task performance of participants with a lot of experience playing *Super Mario* video games is perhaps reflective of underlying differences in the cognitive abilities of these participants relative to less experienced gamers (Lehman & Suefert, 2017). Future research should investigate how the task performance of gamers (vs. non-gamers) differs as a function of their cognitive ability in the presence and absence of different types of music.

Of course, the current study was limited by the fact that only one type of task performance was assessed and only two video game franchises were investigated. A verbal reasoning test was chosen because it seemed plausible (given prior research using similar tasks) that listening to music might either help or hinder performance depending on characteristics of both the music and of participants (Furnham & Allass, 1999; Furnham & Bradley, 1997; Kallinen, 2002). This test also seemed most relevant to the types of tasks that undergraduates commonly encounter in their everyday life (Calderwood et al., 2014; Fox et al., 2009). Moreover, songs from *The Sims* and *Super Mario* media franchises were selected because they have been explicitly identified in the popular press as possibly beneficial for task performance (Ferro, 2018). However, previous research has shown that the effect of music varies across different types of tasks (Kampfe, 2010), and it remains possible that music from other video game franchises might serve to influence task performance differently than the selections used in the current study. Future research might consider examining the influence of video game music on tasks involving cognitive abilities that are thought to be specifically trained by playing video games (e.g., visual acuity, attention; Green et al., 2015) using music from other video game franchises that differs more substantially from the typical forms of orchestral music most often used in studies of task performance. Such work would clarify whether the current results generalize to other tasks and to other music.

Despite these limitations, the current study provided a robust empirical test of a popular lay belief about video game music. There was little indication that video game music operates on mood, arousal, attention, and task performance in ways that are unique from other types of music. These findings highlight the importance of using empirical research as a tool to address popular misinterpretations of scientific evidence, particularly those that are rooted in notably persistent neuromyths.

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Table 1

Songs Included in Edited Medleys

Classical		***The Sims***		***Super Mario***	
Slow Tempo	**Fast Tempo**	**Slow Tempo**	**Fast Tempo**	**Slow Tempo**	**Fast Tempo**
Andante Joseph Haydn (80)	*Farandole* Georges Bizet (120)	*Simmering Mallets* Sims 3 (88)	*Simply Assembly* Sims 3 (128)	*Deep Sea Mare* Super Mario Sunshine (60)	*Delfino Plaza* Super Mario Sunshine (136)
Scottisch Franz Schubert (80)	*Romeo & Juliet No. 1* Prokofiev (132)	*Simple Directions* Sims 3 (96)	*Don't Be Parsimonious* Sims 3 (120)	*Dire Dire Docks* Mario 64 (68)	*Bomb-Omb Battlefield* Mario 64 (112)
Fanfare Unknown (70)	*Swan Lake Ballet* Tchaikovsky (124)	*Expansive Vistas* Sims 3 (88)	*Sales on Isle Six* Sims 3 (140)	*Underwater* New Super Mario Bros (64)	*Aquatic Race* Super Mario Galaxy (152)

Note. Song titles are listed in italics. The composer of the song (for classical music) and the media franchise where the song was derived (for video game music) are listed below each title. The average beats per minute of each song is reported in parentheses. Edited medleys are available at the same OSF link listed in the results section.

Table 2

Effects of Music Type on all Dependent Variables

	Classical		***The Sims***		***Super Mario***	
	Silence	**Music**	**Silence**	**Music**	**Silence**	**Music**
	M (*SE*)	*M* (*SE*)	*M* (*SE*)	*M* (*SE*)	*M* (*SE*)	*M* (*SE*)
Mood	3.757 (.090)	3.688 (.097)	3.838 (.091)	3.806 (.098)	3.861 (.089)	3.687 (.096)
Arousal	3.296 (.083)	3.532 (.091)	3.396 (.084)	3.741 (.092)	3.252 (.083)	3.687 (.090)
Distraction	4.498 (.119)	4.934 (.114)	4.341 (.120)	4.892 (.115)	4.248 (.118)	4.988 (.113)
GRE Score	4.872 (.191)	5.096 (.194)	4.907 (.192)	4.728 (.196)	5.194 (.189)	4.762 (.192)

Note. Mood, arousal, and distraction scores could range from 1 to 7. GRE scores could range from 0 to 20.

Table 3

Effects of Music Tempo on all Dependent Variables

	Slow Tempo		**Fast Tempo**	
	Silence	**Music**	**Silence**	**Music**
	M (*SE*)	*M* (*SE*)	*M* (*SE*)	*M* (*SE*)
Mood	3.803 (.073)	3.859 (.079)	3.834 (.073)	3.595 (.079)
Arousal	3.364 (.068)	3.403 (.074)	3.266 (.068)	3.903 (.074)
Distraction	4.433 (.097)	4.844 (.093)	4.293 (.097)	5.032 (.093)
GRE Score	4.900 (.156)	4.755 (.158)	5.081 (.156)	4.969 (.159)

Note. Mood, arousal, and distraction scores could range from 1 to 7. GRE scores could range from 0 to 20.